MEPAG Goals Document
2008 Revision

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2008 Goals Committee Members

- Jeff Johnson (USGS), Chair

- Goal I: Life
  - Jan Amend (Wash. Univ.) → Tori Hoehler (NASA Ames)
  - Andrew Steele (Carnegie) → Frances Westall (CNRS, France)

- Goal II: Climate
  - Scot Rafkin (SWRI)
  - Steve Bougher (Univ. Michigan) → Paul Withers (Boston Univ.)

- Goal III: Geology
  - Vicky Hamilton (Univ. Hawaii)
  - Jeff Plescia (APL/JHU)

- Goal IV: Human Exploration
  - Abhi Tripathi (JSC)
  - Jennifer Heldmann (NASA Ames)

Goal document location: *http://mepag.jpl.nasa.gov/reports/index.html*

Revision of the Goals Document

- 2008 MEPAG Goals Document is the fifth edition
  - 2001: Original
  - 2004: Major Revision
  - 2005, 2006: Minor Maintenance
- Goals Document has proved useful in forward planning activities (e.g., ND-SAG)
- 2007/2008 has been a time for a review, reconsideration, and update of:
  - Basic scientific strategies embodied in the Goals Document
  - Structure and priority of the scientific Objectives and Investigations
  - How the priorities relate to the Mars Exploration Plan

MEPAG Goals Document Revision Process Flowchart

1

Goals Committee reviewed state of Mars knowledge at 7th Mars Conference via:
- *Content of technical programs*
- *Formal wrap-up discussions after each session*
- *Discussion with members of the Mars Community*

2

Draft revision of Goals Document prepared by Goals Committee, based on 7th Mars inputs

3

Draft posted on MEPAG website for comment, along with survey questions *(8/20/07)*

4

Community comments gathered via website *(through 9/28/07)*

5

Draft Document is revised by Goals Committee

revise

6

MEPAG Executive Committee provides comments

revise

7

MEPAG Meeting (*2/08*) provides opportunity for community discussion (breakout session for each Goal, chaired by respective Goal Representatives)

revise

8

Goals Committee incorporates MEPAG suggestions

9

Release Goals Document (LPSC, 2008)

Revision of the Goals Document

- Originally scheduled for release during March LPSC…
- …waited on inputs from Goal I representatives…
- …received final inputs on Monday of this week
- Goal IV updates are scheduled for update in 2009
  - Allow for inputs from Design Reference Architecture
  - This revision should begin this fall
  - Expect Goal IV updates to Goals Document by next MEPAG meeting (#20)

Changes from 2006 version (1)

- Table of Contents
- Goal I (Life):
  - Wording changes
- Goal II (Climate):
  - Goal II, Objective C ➔ Goal IV, Objective C
    - *Characterize the State and Processes of the Martian Atmosphere of Critical Importance for the Safe Operation of Both Robotic and Human Spacecraft*
  - Revised emphasis on Polar Science in Goal II, Objective B
    - *<u>2. Investigation:</u> Determine the chronology, including absolute ages, of compositional variability, and determine the record of recent climatic change expressed in the stratigraphy of the PLD.*
    - *<u>3. Investigation:</u> Relate low latitude terrain softening and periglacial features to past climate eras.*

Goal II Objectives

2006

A. Objective: Characterize Mars' Atmosphere, Present Climate, and Climate Processes

B. Objective: Characterize Mars' Ancient Climate and Climate Processes Through Study of the Geologic and Volatile Record of Climate Change

C. Objective: Characterize the State and Processes of the Martian Atmosphere of Critical Importance for the Safe Operation of Spacecraft (➔ became Goal IV.C)

2008

A. Objective: Characterize Mars' Atmosphere, Present Climate, and Climate Processes Under Current Orbital Configuration

B. Objective: Characterize Mars' Recent Climate History and Climate Processes Under Different Orbital Configurations

C. Objective: Characterize Mars' Ancient Climate and Climate Processes

Changes from 2006 version (2)

- Goal III:
  - Reordered priorities in Objective A
    - *Determine the nature and evolution of the geologic processes that have created and modified the Martian crust*
  - New Objective C (formerly III.B.4)
    - *Understand the origin, evolution, composition and structure of Phobos and Deimos*

III

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1. Investigation: Determine the present state, 3-dimensional distribution, and cycling of water on Mars.

2. Investigation: Evaluate fluvial, subaqueous, pyroclastic, subaerial, and other sedimentary processes and their evolution and distribution through time, up to and including the present.

3. Investigation: Calibrate the cratering record and absolute ages for Mars.

4. Investigation: Evaluate igneous processes and their evolution through time, including the present.

5. Investigation: Characterize surface-atmosphere interactions on Mars, including polar, Aeolian, chemical, weathering, mass-wasting and other processes.

6. Investigation: Determine the large-scale vertical structure and chemical and mineralogical composition of the crust and its regional variations. This includes, for example, the structure and origin of hemispheric dichotomy.

7. Investigation: Document the tectonic history of the Martian crust, including present activity.

8. Investigation: Evaluate the distribution and intensity of hydrothermal processes through time, up to and including the present.

9. Investigation: Determine the processes of regolith formation and subsequent modification, including weathering and diagenetic processes.

10. Investigation: Determine the nature of crustal magnetization and its origin.

11. Investigation: Evaluate the effect of impacts on the evolution of the Martian crust.

III

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1. Investigation: Determine the formation and modification processes of the major geologic units and surface regolith as reflected in their primary and alteration mineralogies.

2. Investigation: Evaluate volcanic, fluvial/laucustrine, hydrothermal, and polar erosion and sedimentation processes that modified the Martian landscape over time.

3. Investigation: Constrain the absolute ages of major Martian crustal geologic processes, including sedimentation, diagenesis, volcanism/plutonism, regolith formation, hydrothermal alteration, weathering, and the cratering rate.

4. Investigation: Hydrothermal environments.

5. Investigation: Evaluate igneous processes and their evolution through time.

6. Investigation: Characterize surface-atmosphere interactions on Mars, as recorded by aeolian, glacial/periglacial, fluvial, chemical and mechanical erosion, cratering and other processes.

7. Investigation: Determine the tectonic history and large-scale vertical and horizontal structure of the crust, including present activity. This includes, for example, the structure and origin of hemispheric dichotomy.

8. Investigation: Determine the present state, 3-dimensional distribution, and cycling of water on Mars including the cryosphere and possible deep aquifers.

9. Investigation: Determine the nature of crustal magnetization and its origin.

10. Investigation: Evaluate the effect of large-scale impacts on the evolution of the Martian crust.

Changes from 2006 version (3)

- Inclusion of “Cross-cutting strategies” section

Updating our Strategies for the Next Decade

- Although we are not done with the "Follow the Water" strategy, we have made so much progress we need a new headliner.
- MEPAG help is requested
- Some draft possibilities:

  Introduced in past planning activities

  - Understand Mars as a System (and its evolution through time)
  - Seek Habitable Environments

  Possible new ideas

  - Understanding Current and Past Environments on Mars
    - Implications for the Origin and Evolution of Life
    - Implications for Earth and its Environments
  - Seek (possible) habitats, hunt for habitats
  - Evaluate environments
  - TBD
- Send additional ideas to: Dave Beaty *(David.Beaty@jpl.nasa.gov)*

Goal II.A 2006

1. Investigation: Determine the processes controlling the present distributions of water, carbon dioxide, and dust by determining the short and long-term trends (daily, seasonal and solar cycle) in the present climate. Determine the present state of the upper atmosphere (neutral/plasma) structure and dynamics; quantify the processes that link the Mars lower and upper atmospheres.

2. Investigation: Search for microclimates.

3. Investigation: Determine the production/loss, reaction rates, and global 3-dimensional distributions of key photochemical species (O3, H2O2, CO, OH, CH4, SO2, etc.), and their interaction with surface materials.

Goal II.A 2008

1. Investigation: Determine the processes controlling the present distributions of water, carbon dioxide, and dust by determining the short- and long-term trends (daily, seasonal and solar cycle) in the present climate. Determine the present state of the upper atmosphere (neutral/plasma) structure and dynamics; quantify the processes that link the Mars lower and upper atmospheres.

2. Investigation: Determine the production/loss, reaction rates, and global 3-dimensional distributions of key photochemical species (e.g., O3, H2O, CO, OH, CH4, SO2), the electric field and key electrochemical species (e.g., H2O2), and the interaction of these chemical species with surface materials.

3. Investigation: Understand how volatiles and dust exchange between surface and atmospheric reservoirs, including the mass and energy balance. Determine how this exchange has affected the present distribution of surface and subsurface ice as well as the Polar Layered Deposits (PLD).

4. Investigation: Search for microclimates.

Goal II.C 2008

C. Objective: Characterize Mars' Ancient Climate and Climate Processes (investigations in priority order)

1. Investigation: Determine the rates of escape of key species from the Martian atmosphere, their correlation with seasonal and solar variability, the influence of remnant crustal magnetic fields, and their connection with lower atmosphere phenomenon (e.g., dust storms). From these observations, quantify the relative importance of processes that control the solar wind interaction with the Mars upper atmosphere in order to establish the magnitude of associated volatile escape rates. FORMERLY II.B.2

2. Investigation: Find physical and chemical records of past climates. FORMERLY II.B.4

3. Investigation: Determine how the stable isotopic, noble gas, and trace gas composition of the Martian atmosphere has evolved through time from the ancient climate state. FORMERLY II.B.3